(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 990 816 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
05.04.2000 Bulletin 2000/14

(51) Int. Cl.[7]: **F16F 9/00**

(21) Application number: **99119360.8**

(22) Date of filing: **29.09.1999**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **30.09.1998 JP 27853798**

(71) Applicant:
**Dow Corning Toray Silicone Company, Ltd.
Chiyoda-ku, Tokyo 100-0005 (JP)**

(72) Inventors:
- **Teishi, Mari Ta,
Dow Corning Toray Silicone Comp.
Ichihara-shi, Chiba Prefecture (JP)**
- **Akamatsu, Shoji,
Dow Corning Toray Silicone Comp.
Ichihara-shi, Chiba Prefecture (JP)**

(74) Representative:
**Spott, Gottfried, Dr.
Spott & Weinmiller
Patentanwälte
Sendlinger-Tor-Platz 11
80336 München (DE)**

(54) **Vibration damping composition**

(57) The present invention relates to a vibration damping composition comprising (A) 95-25 wt% of a viscous liquid and (B) 5-75 wt% of at least two solid powders having different average particle diameters, wherein the difference between the respective average particle diameters of the solid powders is at least 10 μm. The vibration damping compositions of this invention are superior in vibration damping properties and possess a stable vibration damping characteristic that is not significantly affected by temperature changes.

EP 0 990 816 A1

Description

FIELD OF THE INVENTION

[0001] The present invention r lates to a vibration damping composition comprising a viscous liquid and solid powders. More particularly, this invention relates to a vibration damping composition possessing stable vibration damping characteristics which are not significantly affected by temperature changes.

BACKGROUND OF THE INVENTION

[0002] Vibration damping compositions containing viscous liquids and solid powders have been disclosed. For example, in Japanese Patent Publication No. 62113932 is disclosed a vibration damping composition containing water, liquid polymers such as diethylene glycol, glycerin, or polybutadiene, and clay mineral powders. In Japanese Patent Publication No. 63308241 is disclosed vibration damping compositions containing viscous liquids, such as silicone oil, and solid powders, such as silica powder, glass powder, and silicone resin powder. In Japanese Patent Publication No. 63308242 are disclosed vibration damping compositions containing viscous liquids, such as silicone oil, and powders of organic resins whose glass transition point is within the working temperature range, such as acrylic resins.

[0003] In addition, in Japanese Patent Publication No. 10251517 a vibration damping composition possessing excellent vibration characteristics even if the frequency of vibration changes was disclosed by the authors of the present invention. The vibration damping effects of these vibration damping compositions, however, varied depending on temperature changes, and they did not possess stable vibration damping characteristics.

SUMMARY OF THE INVENTION

[0004] The present invention relates to a vibration damping composition comprising (A) 95-25 wt% of a viscous liquid and (B) 5-75 wt% of at least two solid powders having different average particle diameters, wherein the difference between the respective average particle diameters of the solid powders is at least 10 µm.

[0005] It is an object of the present invention to provide a vibration damping composition superior in vibration damping properties and possessing a stable vibration damping characteristic that is not significantly affected by temperature changes.

DETAILED DESCRIPTION OF THE INVENTION

[0006] The present invention relates to a vibration damping composition comprising (A) 95-25 wt% of a viscous liquid and (B) 5-75 wt% of at least two solid powders having different average particle diameters, wherein the difference between the respective average particle diameters of the solid powders is at least 10 µm.

[0007] In the composition of this invention, Component (A), the viscous liquid is a medium used for dispersing the solid powders, Component (B). The viscous liquid (A) is exemplified by mineral oil, vegetable oil, synthetic oil, and silicone oil. Preferably the viscous liquid is a silicone oil because of its high compressibility, weak dependence of changes in viscosity on temperature, and superior heat resistance. Organopolysiloxanes having a siloxane backbone are recommended as the silicone oil, with the organopolysiloxane preferably containing groups exemplified by alkyl groups such as methyl, ethyl and propyl, alkenyl groups such as vinyl and butenyl, aryl groups, such as phenyl and tolyl, halogenated alkyl groups such as 3,3,3-trifluoropropyl, and other substituted or unsubstituted monovalent hydrocarbon groups, and, additionally, a small amount of hydroxyl groups, methoxy groups, ethoxy groups, or other alkoxy groups as the groups bonded to the silicon atom in such siloxanes. Among them, in terms of the weak dependence of changes in viscosity on temperature and the excellent storage stability of the composition of the present invention, alkyl groups are preferable, with the methyl group being particularly preferred. Also, the molecular structures of such silicone oils are exemplified by linear, partially branched linear, branched, and cyclic structures, with the linear structure being particularly preferred. The kinematic viscosity of such silicone oils at 25°C is, preferably, within the range of from 100 mm^2/s to 1,000,000 mm^2/s, with the range of from 500 mm^2/s to 500,000 mm^2/s being even more preferable. This is due to the fact that if the kinematic viscosity at 25°C is less than 100 mm^2/s, maintaining the solid powders in a dispersed state tends to become impossible, and, on the other hand, if it exceeds 1,000,000 mm^2/s, the handling properties deteriorate, and it becomes more difficult to disperse the solid powders. Preferred silicone oils as Component (A) are exemplified by trimethylsiloxy-endblocked polydimethylsiloxanes and trimethylsiloxy-endblocked polydimethylsiloxane-polymethylphenylsiloxane copolymers. The content of the viscous fluid, Component (A) in the compositions of this invention, is typically from 95 wt% to 25 wt%, preferably from 91 wt% to 30 wt%, and, more preferably from 80 wt% to 30 wt%. This is due to the fact that if the amount of the added viscous fluid is not within this range, the vibration damping characteristics of the compositions of this invention tends to deteriorate.

[0008] The solid powder, Component (B), used in the compositions of this invention, which is a component intended for imparting vibration damping properties to the composition of the present invention, is a mixture of two or more solid powders with different average particle diamet rs. It is necessary that the difference in the particle diameters, based on the average particle diameter, of those two or more solid powders should be at least 10 µm, with 15 µm or more being preferable. The average particle diameters of the solid powders are usually within the range of from 1 µm to 200 µm, and, preferably, within the range of from 10 µm to 150 µm, with a mixture of (B1) a solid powder with an average particle diameter of 1 µm to 50 µm and (B2) a solid powder with an average particle diameter of 20 µm to 200 µm being particularly preferred as the solid powder of the present invention. The solid powders are exemplified by inorganic powders such as silica powder, calcium carbonate powder, and glass powder, organic resin powders such as polyethylene resin powder and acrylic resin powder, and silicone resin powder. As for their shape, spherical, oblate, and irregular shape are suggested. It is preferable to combine powders of different materials, with a combination of a calcium carbonate powder with an average particle diameter of about 10-30 µm and a glass powder with an average particle diameter of about 70-120 µm being especially preferred. The content of the solid powders in the composition of the present invention is within the range of from 5 wt% to 75 wt%, preferably, within the range of from 9 wt% to 70 wt%, and, more preferably, within the range of from 20 wt% to 70 wt%. This is due to the fact that if the amount of the added solid powders is not within this range, the vibration damping characteristic tends to deteriorate. In addition, the proportion, in which the above mentioned solid powder of component (B1) and solid powder of component (B2) are mixed, is, preferably, such that component (B2) constitutes not more than 40 w% of component (B1).

[0009] The composition of the present invention comprises the above mentioned viscous liquid (A) and solid powders (B), but other optional components, such as clay, bentonite, silica micropowder, metallic soap, and other thickeners, anti-oxidants, rust preventives, flame resistance imparting agents, pigments, and dyes, may be added thereto as well.

[0010] The composition of the present invention is produced by homogeneously mixing the above mentioned viscous liquid (A) and solid powders (B). Kneading techniques employing well-known kneading equipment, such as ball mills, vibrating mills, kneader-mixers, screw extruders, paddle mixers, ribbon mixers, Henschel mixers, jet mixers, Hobart mixers, roller mixers, and the like, are suggested as the means for mixing the viscous liquid (A) and solid powders (B).

[0011] The composition of the present invention as described above is superior in vibration damping properties and has the advantage of insignificant temperature dependency, which results in an excellent vibration damping characteristic even if the temperature fluctuates. For this reason, by placing it in containers made of elastic material to obtain shock-absorbing members, the vibration damping composition of the present invention can be utilized in shock-absorbing members used in electrical equipment, such as compact disc players, compact disc changers, minidisc players, and car navigation devices.

EXAMPLES

[0012] In the examples hereinbelow, the kinematic viscosity is a value measured at 25°C.

Example 1

[0013] About 1000 g of a trimethylsiloxy-endblocked polydimethylsiloxane having a kinematic viscosity of 60,000 mm^2/s, 1620 g of irregular-shaped calcium carbonate with an average particle diameter of 20 µm, and 360 g of spherical glass beads with an average particle diameter of 80-110 µm were placed in a Hobart mixer (made by Hobart) and mixed at a low speed for one hour, with scraping carried out every 30 minutes. The vibration damping characteristics ($\tan\delta$) of the thus obtained vibration damping composition at -20°C, 25°C, and 60°C were measured by the plate method using a rheometric dynamic analyzer (from RHEOMETRICS Inc.; RDA-700) (measurement conditions: plate diameter: 20 mm, frequency: 10 Hz, strain: 20%, sample thickness: 1 mm). Subsequently, ratios to $\tan\delta$ at 25°C ($\tan\delta/\tan\delta(25°C)$) were obtained from these results. The results are listed in Table 1.

Example 2

[0014] Except for adding spherical glass beads with an average particle diameter of 40-80 µm instead of the spherical glass beads with an average particle diameter of 80-110 µm used in Example 1, a vibration damping composition was prepared in the same manner as in Example 1. The $\tan\delta$ of the resultant vibration damping composition at -20°C, 25°C, and 60°C were measured in the same manner as in Example 1, obtaining ratios to $\tan\delta$ at 25°C from these results. The results are listed in Table 1.

Example 3

[0015] Except for adding a trimethylsiloxy-endblocked polydimethylsiloxane having a kinematic viscosity of 100,000

mm^2/s instead of the trimethylsiloxy-endblocked polydimethylsiloxane having a kinematic viscosity of 60,000 mm^2/s used in Example 1, a vibration damping composition was prepared in the same manner as in Example 1. The tanδ of the resultant vibration damping composition at -20°C, 25°C, and 60°C were measured in th sam manner as in Exampl 1, obtaining ratios to tanδ at 25°C from these results. The results are listed in Table 1.

Comparative Example 1

[0016] A vibration damping composition was prepared in the same manner as in Example 1, except that the spherical glass beads used in Example 1 were not added. The tanδ of the resultant vibration damping composition at -20°C, 25°C, and 60°C were measured in the same manner as in Example 1, obtaining ratios to tanδ at 25°C from these results. The results are listed in Table 1.

Comparative Example 2

[0017] A vibration damping composition was prepared in the same manner as in Example 1, with the exception that spherical glass beads with an average particle diameter of 15 µm were added instead of the spherical glass beads with an average particle diameter of 80-110 µm used in Example 1. The tanδ of the resultant vibration damping composition at -20°C, 25°C, and 60°C were measured in the same manner as in Example 1, obtaining ratios to tanδ at 25°C from these results. The results are listed in Table 1.

Table 1

	Vibration Damping Characteristic (tanδ) at 25°C	Vibration Damping Characteristic [tanδ/tanδ(25°C)]	
		-20°C	60°C
Application Example 1	3.90	0.52	1.50
Application Example 2	9.10	0.40	1.67
Application Example 3	3.09	0.62	1.56
Comparative Example 1	15.8	0.37	1.70
Comparative Example 2	12.9	0.38	1.77

[0018] It can be seen from Table 1 that the compositions of this invention possess superior vibration damping properties and a stable vibration damping characteristic that is not significantly affected by temperature changes.

Claims

1. A vibration damping composition comprising:

   (A) 95-25 wt% of a viscous liquid; and
   (B) 5-75 wt% of at least two solid powders having different average particle diameters wherein the difference between the respective average particle diameters of the solid powders is at least 10 µm.

2. A composition according to Claim 1, wherein (A) is selected from the group consisting of mineral oil, vegetable oil, synthetic oil, and silicone oil.

3. A composition according to Claim 2, wherein (A) is a silicone oil.

4. A composition according to Claim 3, wherein the silicone oil has a kinematic viscosity of from 100 mm^2/s to 1,000,000 mm^2/s at 25°C.

5. A composition according to Claim 3, wherein the silicone oil has a kinematic viscosity of from 500 mm^2/s to 500,000 mm^2/s at 25°C.

6. A composition according to Claim 3, wherein the silicone oil is selected from the group consisting of trimethylsiloxy-

endblocked polydimethylsiloxanes having a kinematic viscosity of from 100 mm^2/s to 1,000,000 mm^2/s at 25°C and trimethylsiloxy-endblocked polydimethylsiloxane-polymethylphenylsiloxan copolymers having a kinematic viscosity of from 100 mm^2/s to 1,000,000 mm^2/s at 25°C.

7. A composition according to Claim 3, wherein the silicone oil is selected from the group consisting of trimethylsiloxy-endblocked polydimethylsiloxanes having a kinematic viscosity of from 500 mm^2/s to 500,000 mm^2/s at 25°C and trimethylsiloxy-endblocked polydimethylsiloxane-polymethylphenylsiloxan copolymers having a kinematic viscosity of from 500 mm^2/s to 500,000 mm^2/s at 25°C.

8. A composition according to Claim 1, wherein the difference between the respective average particle diameters of the solid powders is at least 15 µm.

9. A composition according to Claim 7, wherein the difference between the respective average particle diameters of the solid powders is at least 15 µm.

10. A composition according to Claim 1, wherein the average particle diameters of the solid powders are from 1 µm to 200 µm.

11. A composition according to Claim 7, wherein the average particle diameters of the solid powders are from 1 µm to 200 µm.

12. A composition according to Claim 1, wherein the average particle diameters of the solid powders are from 10 µm to 150 µm.

13. A composition according to Claim 7, wherein the average particle diameters of the solid powders are from 10 µm to 150 µm.

14. A composition according to Claim 1, wherein Component (B) is a mixture of (B1) a solid powder with an average particle diameter of 1 µm to 50 µm and (B2) a solid powder with an average particle diameter of 20 µm to 200 µm.

15. A composition according to Claim 7, wherein Component (B) is a mixture of (B1) a solid powder with an average particle diameter of 1 µm to 50 µm and (B2) a solid powder with an average particle diameter of 20 µm to 200 µm.

16. A composition according to Claim 1, wherein (B) is selected from the group consisting of inorganic powders, organic resin powders, and silicone resin powders.

17. A composition according to Claim 14, wherein (B1) and (B2) are each independently selected from the group consisting of inorganic powders, organic resin powders, and silicone resin powders.

18. A composition according to Claim 15, wherein (B1) and (B2) are each independently selected from the group consisting of inorganic powders, organic resin powders, and silicone resin powders.

19. A composition according to Claim 16, wherein the organic powder is selected from the group consisting of silica powder, calcium carbonate powder, and glass powder, and the organic resin powder is selected from the group consisting of polyethylene resin powder and acrylic resin powder.

20. A composition according to Claim 17, wherein the organic powder is selected from the group consisting of silica powder, calcium carbonate powder, and glass powder, and the organic resin powder is selected from the group consisting of polyethylene resin powder and acrylic resin powder.

21. A composition according to Claim 18, wherein the organic powder is selected from the group consisting of silica powder, calcium carbonate powder, and glass powder, and the organic resin powder is selected from the group consisting of polyethylene resin powder and acrylic resin powder.

22. A composition according to Claim 1, wherein (B) is a combination of a calcium carbonate powder with an average particle diameter of about 10-30 µm and a glass powder with an average particle diameter of about 70-120 µm.

23. A composition according to Claim 7, wherein (B) is a combination of a calcium carbonate powder with an average

particle diameter of about 10-30 μm and a glass powder with an average particle diameter of about 70-120 μm.

24. A composition according to Claim 21, wherein (B) is present in an amount of from 20 wt% to 70 wt% and (B2) constitutes not more than 40 w% of component (B1).

25. A composition according to Claim 1, wherein the composition further comprises at least one ingredient selected from the group consisting of clay, bentonite, silica micropowder, metallic soap, thickeners, antioxidants, rust prev n-tives, flame resistance imparting agents, pigments, and dyes.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 11 9360

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
D,X	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 14, 31 December 1998 (1998-12-31) & JP 10 251517 A (TORAY DOW CORNING SILICONE CO LTD), 22 September 1998 (1998-09-22) * abstract * -& DATABASE CHEMABS [Online] CHEMICAL ABSTRACTS SERVICE, COLUMBUS, OHIO, US STN, CAPLUS accession no. 1998:613797, XP002126988 * abstract *	1-25	F16F9/00
A	DE 32 07 654 A (SCHIEDEL GMBH & CO) 28 October 1982 (1982-10-28) * claims *	2,4-7,25	
A	EP 0 677 574 A (LUBRIZOL CORP) 18 October 1995 (1995-10-18) * page 3, line 5 - page 4, line 35; claim 8 *	2,16-21	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
A	DE 21 15 123 A (BREED D) 5 October 1972 (1972-10-05) * claims 2-6,11,12 *	4-7, 16-21	F16F
A	DE 32 34 469 A (MATARO CO LTD) 22 March 1984 (1984-03-22) * claim 8 *	6,7	
A	DE 23 02 657 A (RAUFOSS AMMUNISJONSFABRIKKER) 2 August 1973 (1973-08-02) * claims *	4-7	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	10 January 2000	Pöll, A

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 99 11 9360

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

10-01-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 10251517 A	22-09-1998	NONE	
DE 3207654 A	28-10-1982	AT 15689 T	15-10-1985
		WO 8203086 A	16-09-1982
		EP 0059936 A	15-09-1982
		EP 0073224 A	09-03-1983
		JP 57168997 A	18-10-1982
		JP 58500408 T	17-03-1983
		US 4416790 A	22-11-1983
		US 4686057 A	11-08-1987
EP 0677574 A	18-10-1995	US 5445760 A	29-08-1995
		AU 1632495 A	26-10-1995
		CA 2146949 A	15-10-1995
		JP 8041479 A	13-02-1996
DE 2115123 A	05-10-1972	NONE	
DE 3234469 A	22-03-1984	NONE	
DE 2302657 A	02-08-1973	NO 129970 B	17-06-1974
		CA 983962 A	17-02-1976
		FR 2168526 A	31-08-1973
		GB 1424772 A	11-02-1976
		IT 976944 B	10-09-1974
		JP 50047075 A	26-04-1975
		AU 475572 B	26-08-1976
		AU 5271273 A	29-08-1974

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82